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SENSE OF A PRESENCE AND SUICIDAL IDEATION FOLLOWING TRAUMATIC BRAIN INJURY: INDICATIONS OF RIGHT-HEMISPHERIC INTRUSIONS FROM NEUROPSYCHOLOGICAL PROFILES [1]

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Summary.—50 patients who had sustained a traumatic brain injury were given complete neuropsychological assessments between 0.5 and 4.0 years after the incident; 62% of these patients reported that episodes of a "sensed presence" (left side: 71%; right side: 19%; both: 10%) had occurred. Sensed presences along the left side were primarily (82%) associated with anxiety or fear while those which occurred along the right side were more pleasant (83%). The neuropsychological profiles of patients who reported these experiences suggested elevated complex partial epileptic-like signs and a pattern of mild dysfunction within the right prefrontal and temporoparietal lobes which would promote brief hypermetabolic periods within the latter region. Patients who displayed this profile in conjunction with fragmentation of the self-concept and concomitantly lowered left-hemispheric linguistic functions reported more frequent suicidal impulses. The results are compatible with the hypothesis that the "sense of a presence" is an intrusion of the right-hemispheric homologue of the sense of self into left-hemispheric awareness.

The sense of self has been hypothesized to be the consequence of an aggregate of neuronal operations that primarily involve left-hemispheric (linguistic) processes (Edelman, 1989; MacLean, 1990). When this right-hemispheric equivalent of the sense of self intrudes into awareness, the person experiences a "sensed presence" or an "entity" (Persinger, 1993b). Although the experience and its contents are determined by the neuroanatomical parameters of the human brain and individual reinforcement history, the explanation (or attribution) of these experiences would be determined by the experient's culture. Under normal conditions these intrusions should be prevented by the reciprocal inhibition of collaterals from commissural (callosal) fibers between the two hemispheres. Interhemispheric disequilibrium (induced by disruption of shear or strain by the corpus callosum and anterior commissure) frequently follows closed-head injury. If this model is valid, then a specific subpopulation of people with acquired (traumatic) brain injury should exhibit a marked increase in these experiences.

The vectorial hemisphericity model (Persinger, 1993a, 1993b) assumes that both subjective experiences and overt behaviors are determined by those portions of the brain which are most metabolically active. Focal and regional

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metabolic anomalies which encourage relative increases in right temporoparietal function due to enhanced activity in the latter or decreased activity in the left homologous area should encourage the sensed presence. Both (1) the contralateral relationship between hemispheric stimulation and the egocentric location of the correlative experience and (2) the moderate association of positive and negative affect (emotion) with electrical stimulation of the left and right hemispheres, respectively, should be evident.

If the vectorial hemisphericity model is valid, then (1) a sense of a presence along the left peripheral field should be more frequently associated with negative affect (apprehension, fear) than a presence along the person's right side, (2) patients who report a sense of a presence should exhibit indicators of (a) functional sensory-limbic hyperconnectionism, e.g., enhanced cross-modal matching (Sabourin & Persinger, 1987) and (b) relatively enhanced right temporoparietal function, (3) a right-side presence should be associated with more positive affect, traditional left-hemispheric disruptions in linguistic function, alterations in awareness, and auditory experiences such as "voices" that are attributed to gods or angels, and (4) because the "change in personality" that follows many traumatic brain injuries is more accurately described as fragmentation of the sense of self (Miller, 1993), self-destructive ideation should be more frequent in patients who experience this "loss of self" (inferred by indicators of left temporoparietal disruption) plus right-hemispheric intrusions.

Method

To test the logical extensions of this model, specific neuropsychological test scores, personality indices, complex partial epileptic signs, and structured interviews were obtained for 50 (27 men, 23 women) patients who had been assessed serially over a period of 14 months (their results have not been published previously). All had been referred following a verified or suspected traumatic brain or whiplash injury. The means and standard deviations (in parenthesis) for the relevant demographic data were age 34 (12) years, time since the injury 1.5 (1.1) yr., formal education 12.0 (2.6) yr., and estimated posttraumatic amnesic interval 19 days ($Mdn = 0.25$ days, range = $0 > 99$ days). Of these patients 10% reported they remembered a near-death experience, e.g., out-of-body experience, tunnel experience, contact with deity, at the time of or just after the brain trauma.

The procedures and tasks selected to test the hypotheses have been described elsewhere (Kolb & Whishaw, 1990; Reitan & Wolfson, 1985; Richards & Persinger, 1982). The means and standard deviations for the neuropsychological tests are shown in Table 1. The inference of complex partial epileptic-like experiences ($M = 65$, $SD = 40$) was based on responses to the scale developed by Roberts, Varney, Hulbert, Paulsen, Richardson, Springer, Shepherd, Swan, Legrand, Harvey, and Struchen (1990). Scores on the hy-

pomania (Ma) 67 (12) and eccentric thinking (Sc) 60 (12) scales were obtained from the patients' Minnesota Multiphasic Personality Inventory scores given the traditional association of these two inferential clusters with right- and left-hemispheric function, respectively. All of the Cattell 16 PF (personality) scores were employed; values ranged between 4.1 (1.8) and 6.9 (2.2).

TABLE 1
MEANS AND STANDARD DEVIATIONS FOR VARIOUS NEUROPSYCHOLOGICAL AND PSYCHOMETRIC SCORES FOR 50 PATIENTS

Measure	*M*	*SD*
Speech Sounds Test (of 30)	25.0	3.6
Seashore Rhythm Test (of 30)	24.7	3.1
Dichotic Listening (Right Ear)	34.5	11.9
Dichotic Listening (Left Ear)	34.3	10.6
D Tactual Performance (min.)	6.3	2.9
ND Tactual Performance (min.)	5.6	2.9
Tactual Performance Test		
Memory	6.6	1.7
Localization	3.8	2.6
Category Test (Total Errors)	65.7	32.4
Design Fluency	20.9	10.1
Verbal Fluency (FAS)	35.4	11.2
Stroop Color-Word (*T* Score)	41.3	10.3
Trails A (sec.)	42.1	19.2
Trails B (sec.)	111.2	84.5
Rey-Ostereith Copy	29.1	4.0
Rey-Ostereith Memory	14.7	7.2
Right Finger Tapping	45.2	11.9
Left Finger Tapping	41.8	10.0
Right Foot Tapping	38.1	11.5
Left Foot Tapping	35.5	10.8
Right Finger Agnosia	1.0	2.1
Left Finger Agnosia	1.1	2.4
Right Toe Agnosia	4.5	2.7
Left Toe Agnosia	4.7	2.5
Verbal IQ	89.1	12.3
Performance IQ	94.3	13.2
Memory Quotient (WMS)	94.6	7.6
Halstead-Reitan Impairment Index	0.5	0.3

Analyses involved SPSS software on a VAX 4000 computer. Spearman *rho* correlations (rather than assessing the occurrence or nonoccurrence of statistical significance between the mean values for the groups) were selected as the first level of analyses because they are minimally affected by outliers and they are more obvious estimates of the magnitude (effect size) of group differences. Two basic assumptions were made, (1) complex experiences in-

volve multiregional activity of the brain and (2), as a neuropsychological measure becomes more specific (unique variance), the inferred subset of cerebral volume associated with that measure becomes more circumscribed. Consequently, discriminant analyses and multiple regression analyses (to obtain beta coefficients) were completed. These two multivariate analyses were completed for both the raw scores and their *relative* (z score) values within the context of the individual.

Results and Discussion

A total of 31 (62%) of the traumatically brain-injured patients reported that they had experienced episodes of "a presence" that had begun after the trauma. All but three subjects lateralized their experiences. Estimates by the patients indicated that the experiences began between 3 months and 2 years after the trauma and primarily appeared when the "physical" difficulties had been resolved but questions regarding self-identity had emerged. Patients with the mildest brain (Halstead-Reitan) impairment reported the experiences occurred earlier than those with more severe impairments ($rho = .46$, $p < .01$). [Note: they also reported the earliest onset of depression and suicidal ideation.] Although Roberts' Total Score for complex partial epileptic-like signs was correlated .41 ($p < .01$) with the experience of a presence after the brain trauma, the occurrence of these experiences was not significantly associated with ($rho = .04$, $p > .05$) the Halstead-Reitan Impairment Index.

Binomial analyses (assuming a 50:50 probability for either side) indicated that significantly (z approximation $p = .005$) more of the patients experienced the presence along the left side (22/28) than along the right side (6/28). When the rating of the emotional effects of the experience was considered (neutral, negative, positive), there was a marked discrepancy ($\chi_1^2 = 23.34$, $p < .001$; ϕ coefficient = .91) between the pleasantness of the experience and its spatial location. None of the left-sided presences were positive (18/22 or 82% were negative) while the right-sided presences were considered positive. Of these patients 5/6 or 83% attributed the experiences to a spiritual being, e.g., angel, and specific instructions were "heard." These results support the hypothesis that right temporoparietal activation would be associated with left-sided and apprehensive experiences while phasic left temporoparietal activation secondary to right-hemispheric intrusions would be associated with more pleasant experiences, anomalously activated linguistic processes and ego-alien attributions, e.g., words from a spirit or a god. Point biserial correlations (to display effect size) between the various interval and ratio scales of the test battery and the nonoccurrence or occurrence of a sensed presence were completed. There were no statistically significant associations between any of the other measures (including age of the patient, years of formal education, estimated posttraumatic amnesic interval or the Impairment Index) and the experience of a presence. Reports of sensed pres-

ences (either side) were significantly correlated with a more proficient memory score (.45) for the Tactual Performance Test (TPT), greater interference during the color-word component of the Stroop Test (.35), and lower scores on Verbal Fluency (FAS; .28), the hypomania (Ma) scale (.41) from the MMPI, and Factor O (guilt proneness: .37) from the 16 PF. There was a weak but significant association between the occurrence of a near-death experience (10% of the population) at the time of the injury and subsequent sensed presences ($\phi = 0.31$, $p < .01$).

The occurrence of a sensed presence was also significantly correlated with the following subjective experiences from the Roberts' scale of complex partial epileptic-like indicators: Q_3: seeing "bugs" or "stars" in the peripheral field (.40), Q_4: sensing movement in the peripheral field (.58), Q_{13}: overwhelming feeling that things are weird or strange (.43), Q_{18}: driving without remembering where you were going or how you arrived (.36), Q_{21}: staring and having a blank look on the face (.38), Q_{36}: people saying you become very angry but you don't remember (.38), and Q_{30}: being so depressed that you think of suicide (.36).

Because of the potential confounding effects of the disproportionate representation of left-sided and right-sided sense of presence in these analyses, comparisons were completed for patients who had not experienced (reported) sensed presences and those who had reported presences either along the left side or along the right side. Both of the latter groups exhibited comparable and statistically significant proficient memory on the Tactual Performance Test and elevated hypomania scores compared to those who did not experience a presence. People who reported episodes of a sensed presence along the right side reported more frequent ($p < .01$) (relative to left-sided sense of presence) metallic tastes [Q_2 3.6 (1.8), 1.0 (1.3)], utterance of sentences that did not make sense [Q_{11} 5.4 (0.8), 2.5 (1.8)], episodes of being "hypnotized" by a shiny object [Q_{20} 4.8 (2.6), 1.7 (1.8)], and the experience of a pain in the head that was not a headache [4.8 (1.3), 1.7 (2.2)]. Spearman *rho* associations between patients who had not experienced presences vs those who had experienced them either on the left or right side, respectively, verified the association with Tactual Performance Test memory scores (.41, .45) and mania scores (.42, .40).

Patients who experienced right-side presences displayed significant associations between the reported frequencies of strong and abrupt depressions (Q_{30}) and lower Verbal IQs (- .48) on the WAIS—R [but not Performance IQs (- .18) on the WAIS—R], lower scores on the Speech Sounds Perception Test (- .57) [but not lower scores on the Seashore Rhythms Test (- .17)], and less accurate scores for the Dichotic Word Listening Test (left ear: - .62, right ear: - .59, both ears: - .70). These strong associations were not evident for patients who had experienced presences along the left side.

This pattern is compatible with the model that areas exhibiting lower left temporoparietal function (metabolic hypoperfusion) would be prone to phasic activation. The serial progression would be similar to the reciprocal temporal relation between interictal hypoperfusion and ictal hyperperfusion that occurs in patients who exhibit verified partial epilepsies (Phelps & Mazziotta, 1985; Jibiki & Yamaguchi, 1994). The (Persinger, unpublished) working hypothesis is that lowered hypometabolism (due to neuronal trauma or to the usually correlative alteration in capillary-astroglial capacity) is associated with a slow downward drift in the production of gamma aminobutyric acid (GABA) that is normally produced (via the GABA shunt) during glucose metabolism. During the ictal phase, when hypermetabolism occurs, the anabolistic pathways are accelerated and both the synthesis and the accumulation of this inhibitory transmitter is increased. The anomalous dormancy of inhibitory interneurons (Bekenstein & Lothman, 1993) which followed the brain trauma would be reversed (the interneurons are activated) and the local conditions that promote the formation of paroxysmal discharges would be attenuated.

Before these events occur, when the prolonged hypoperfusion (attenuated metabolism) within the region approaches threshold, the neuronal aggregates within this region become vulnerable to resonance "driving" by right-hemispheric intrusions. These periods of forced activation of left-hemispheric functions by right-hemispheric patterns would be associated with ego-alien narratives, elevated moods and enhanced religiosity (Persinger, 1993b). That there was relative hypometabolism rather than permanent damage within the left temporoparietal region was suggested by the normal magnitude of the standardized scores for the tasks that infer the integrity of function within these cortices.

On the other hand, individuals who reported left-sided presences displayed lower standardized scores for the Rey-Ostereith drawing (.39) [but not memory: −0.15], an elevated Localization component (.37) for the Tactual Performance Test, and greater propensity (.45) to worry, cry (easily), and engage in self-reproach (16 PF Factor O). A more proficient Memory Score for the Tactual Performance Test but greater interference during the Stroop Color-Word test was associated with greater endorsement of suicidal impulses (.43, .50), respectively. All nine of the patients who had experienced a repeated sensed presence (3 right side, 6 left side) and both linguistic dysfunctions and periods of sudden depression, reported the highest scores for suicidal ideation, i.e., more often than once per week since the brain trauma.

To judge whether a specific aggregate of variables could discriminate patients who reported they had experienced a sensed presence relative to those who reported they had not sensed this experience, discriminant analyses were completed for all of the neuropsychological variables and separately for

the personality variables, e.g., hypomania and Roberts' Total Score. The discriminant function (canonical correlation = .72; $\chi^2 = 28.56$, $p < .001$) for the neuropsychological tests correctly classified 85% of the cases. The variables which contributed to the function, the residual lambda values, unstandardized discriminant coefficients, and the standardized (beta values) partial regression coefficients from the multiple regression analysis (to appreciate partial slopes) are presented in Table 2. The use of only the personality variables resulted in a function which included only two variables, hypomania and Roberts' Total Score for complex partial epileptic-like signs (canonical correlation = .53).

TABLE 2
CHARACTERISTICS OF DISCRIMINANT FUNCTIONS* FOR PATIENTS WHO EXPERIENCED NO SENSE OF A PRESENCE VS THOSE WHO EXPERIENCED SENSE OF A PRESENCE

Variable	Lambda	Discriminant Coefficient	Beta
		Absolute Scores	
Trails A	0.87	.07	−.53
Rey-Ostereith Copy	0.70	.20	−.41
Trails B	0.62	−.01	.38
Tactual Performance Test Memory	0.51	−.49	.48
FAS (Verbal)	0.48	.03	−.19
Constant		−5.47	
		Relative *z* Scores	
Trails A	0.82	.50	.55
Tactual Performance Test Memory	0.65	.48	.47
Trails B	0.58	−.11	−.19
Rey-Ostereith Copy	0.49	−.50	−.36
Left Foot Agility	0.46	.50	.30
Constant		.57	

*Lambda; unstandardized discriminant coefficient; beta (standardized partial slope) values.

That hypomania and the cluster of neuropsychological variables which entered the discriminant function were derived from the same or similar source of variance was strongly suggested by subsequent multiple regression. Hypomania scores were predicted ($MR = .62$; $F = 7.76$, $p < .001$) by the patients' poorer Rey-Ostereith (copy) scores (beta = −.46; note: the competitive variable for entry was poorer scores on design fluency, more proficient memory for the Tactual Performance Test (beta = .34) and enhanced accuracy for the right ear during dichotic listening (beta = .46). Roberts' Total Score for complex partial epileptic-like signs exhibited a similar relationship to the performance for these neuropsychological tests.

Both contemporary clinical neuropsychology and the vectorial cerebral hemisphericity model presume that the *relative* differences in standardized scores *within* a person's profile are more accurate indicators of a person's

"cortical mosaic" and more reliable predictors of the patient's strengths and weaknesses. This approach minimizes the between-subject variance and emphasizes the within-subject variance in standardized test scores. To test this assumption, the mean of the standardized scores for the tests (Speech Sounds through left toe agnosia) reported in Table 1 were obtained; each standardized score was then subtracted from this mean. This resulted in quantitative discrepancies (effectively net differences in z scores from the individual's mean of the z scores for all tasks) referenced to the person's functional level.

Discriminant analysis supported the pattern that was obtained for the absolute standardized scores. The discriminant function's canonical correlation coefficient was 0.73 ($\chi_1^2 = 29.38$, $p < .001$) and correctly classified 87% of the cases. The variables (unstandardized coefficients and beta values from the equivalent multiple regression presented in parentheses) whose z-score discrepancies from the individual's aggregate mean constituted the function are also shown in Table 2. Even when individual differences had been reduced by this method, the same aggregate of primary variables, quicker performance on Trails A, more proficient tactile-to-visual cross-modal matching (Tactual Performance Test, memory), less effective ability to alternate between sets (Trails B), and poorer capacity to copy a complex visual spatial (Rey-Ostereith) figure, entered the function.

General Discussion

These results support the validity of the hypothesis that the sense of a presence, which has frequently been attributed to mystical or religious sources, is an intrusion into awareness of the right-hemispheric equivalent of the left-hemispheric sense of self. The affective polarity of the experience is concordant with the probable origin of the electrical transient (Persinger, 1983) which is associated with the experience. The significant correlation between the memory component of the Tactual Performance Test and the occurrence of a sensed presence suggests that the process may involve the same mesiobasal temporal (amygdaloid-hippocampal) pathways that mediate cross-modal matching. Sabourin and Persinger (1987) have shown that complex partial epileptic-like signs reported by normal individuals are positively associated with their accuracy in tactile-to-visual matching. The (1) inclusion of traditional right-hemispheric neuropsychological indicators and (separately) the hypomania factor (also traditionally an inference of right-hemispheric metabolic activity) within the discriminant functions and (2) the evidence that these functions may be derived from the same source of variance suggests that the type of right-hemispheric activation which would promote interhemispheric intercalation could have occurred.

The experience of a sensed presence, an "entity," and other variants of mental diplopia are often considered infrequent or are associated with ex-

treme or unique forms of brain function. Right parietal lobe damage was associated with Critchley's (1953) classic patient who attempted to find "the other person" who appeared to be just out of range of her peripheral vision. Electrical stimulation of the right amygdala has elicited fear and the feeling of someone standing nearby (Gloor, Olivier, Quesney, Andermann, & Horowitz, 1982) while (presumably) rebound temporoparietal stimulation following a right temporal lobectomy for an astrocytoma evoked paroxysmal "feelings of somebody being nearby" without fear (Ardila & Gomez, 1988). However, as suggested by Ardila and Gomez, these unusual experiential phenomena may be quite frequent in clinical settings.

Most of the focus in medical neuropsychology has been directed towards patients who exhibit severe brain injury. Appreciation for the magnitude of the importance of the sense of self and its alteration following even *mild brain trauma* is relatively recent (Miller, 1993; Persinger, 1993a; Prigatano & Klonoff, 1988). When symptoms of depression and "changes in personality" occur, they are often framed within a psychiatric context and are treated by pharmacological strategies that have been extrapolated from populations who display endogenous depression.

According to the hypothesis of vectorial hemisphericity, psychological depression is evoked by disruption in the left-hemispheric linguistic processes which maintain the sense of self and its organization (Persinger, 1993a). The lowered metabolic activity, crudely reflected by positron emission tomography (PET), is simply a gross transcerebral correlate of this disruption. Because general neurofunction is dependent upon selective disinhibition of neuronal aggregates and inhibitory interneurons are among the most vulnerable subset of cells affected by mild shifts in concentrations of glucose and oxygen, periodic failures in inhibitory circuits would be expected. These transients would encourage the intrusion of right-hemispheric equivalents of the sense of self, i.e., the "sense of a presence."

If the general principle that the occurrence of a process also generates its vectorial opposite [a cognitive analogue of Hull's (1952) reactive inhibition] is correct, then these intrusions should be most probable during periods of marked fragility either due to decreased neuronal metabolic activity or to neurocognitive reactions to environmental loss of control or identity. The latter could involve objectively "minor" but subjectively "major" stimuli that are strongly associated with the definition of self such as the unexpected removal of a spouse, a job ritual, or a driver's license.

Intrusions which encourage the dissolution of the sense of self and subsequent self-destructive behaviors would be sudden, relatively brief, and occur during (a) twilight states, (b) normal right-hemispheric dominance (especially if the person remains awake during the late night when dream episodes usually occur), (c) following compensatory overshoots after maintained left-

hemispheric stimulation, and (d) transient elevations of subclinical complex partial epileptic-like signs during phasic depressions of inhibitory neurochemistry, e.g., melatonin, due to geophysical and meteorological stimuli. Clinical attention to the occurrence and increased incidence of a sensed presence in conjunction with disrupted neurolinguistic operations may be useful as a prognostic indicator to help prevent self-destructive thinking and acts.

In addition to the usual potential sampling errors that occur with any referral group, the primary caveat for this study is the likely selection bias for patients who sustained right-hemispheric injuries. Whereas even mild left temporoparietal dysfunctions are clinically conspicuous because there is disruption in linguistic function, mild to moderate electrical dysfunction within the homologous regions of the right hemisphere might not be conspicuous except as "personality" problems until formal and quantitative neuropsychological assessments are completed. Such a selection bias would, therefore, have artifactually increased the incidence of contralateral (left-sided) experiences of a sensed presence. The correlations between the reported sense of a presence and neuropsychological test scores for *single* tests exhibited weak to moderate strengths and suggest either substantial measurement error, marked individual variability, or the existence of a process which was not directly accessed by the single psychometric inferences employed in this study. However, discriminant analyses indicated that only four or five of these tests, approximately combined, accurately discriminated 87% of the 50 subjects and accommodated the equivalence of more than 50% of the variance.

All of the analytical models assumed linearity of associations. If, as we have suspected, regions of the brain which are inferred to exhibit mild deficits are actually prone to brief periods (on the order of 10 min. per 1000 min.) of hypermetabolic activity rather than chronic incapacity, then linear combinations of the measures may have masked the critical variables. The other obvious limitation of this study involves the absence of temporal contiguity between the subjective experiences and the objective measurements; the neuropsychological profiles at the time of the assessments may not have been indicative of the neuromatrix at the time of the sensed presence. If the interhemispheric intercalation also involved extreme transients within the hippocampal formations of some of the patients, the experiences may never have been consolidated (postictal amnesia) and hence could not have been reconstructed.

Within an objective context, the occurrence of these personally profound and delicate experiences after a traumatic brain injury are neither peripheral nor beyond the boundaries of contemporary clinical neuropsychology. When the brain is considered as an electromagnetic matrix that is generated by a spatial-temporal aggregate of units (neurons), then a sudden disruption of this aggregate (the traumatic brain injury) is analogous to a sud-

den impact of energy (radio frequency pulse) that is applied to a hydrogen array. The subsequent recovery (nuclear magnetic resonance "relaxation time") from the impact will be determined by the magnitude of the applied pulse, the complexity of the system (whose parameters constrain the induced consequences of the pulse), and the initial depth of disruption (chaos) within the system. During this period of perturbation, the system would generate transient phenomena whose characteristics change through each dynamic state and whose complexity would increase as the asymptote approached.

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